Sept. 9, 1969 L. F. HANSEN 3,465,496

CAPSULE FORMING APPARATUS WITH FLUID METERING VALVE

Filed Dec. 23, 1966 2 Sheets-Sheet 1

Fig 1

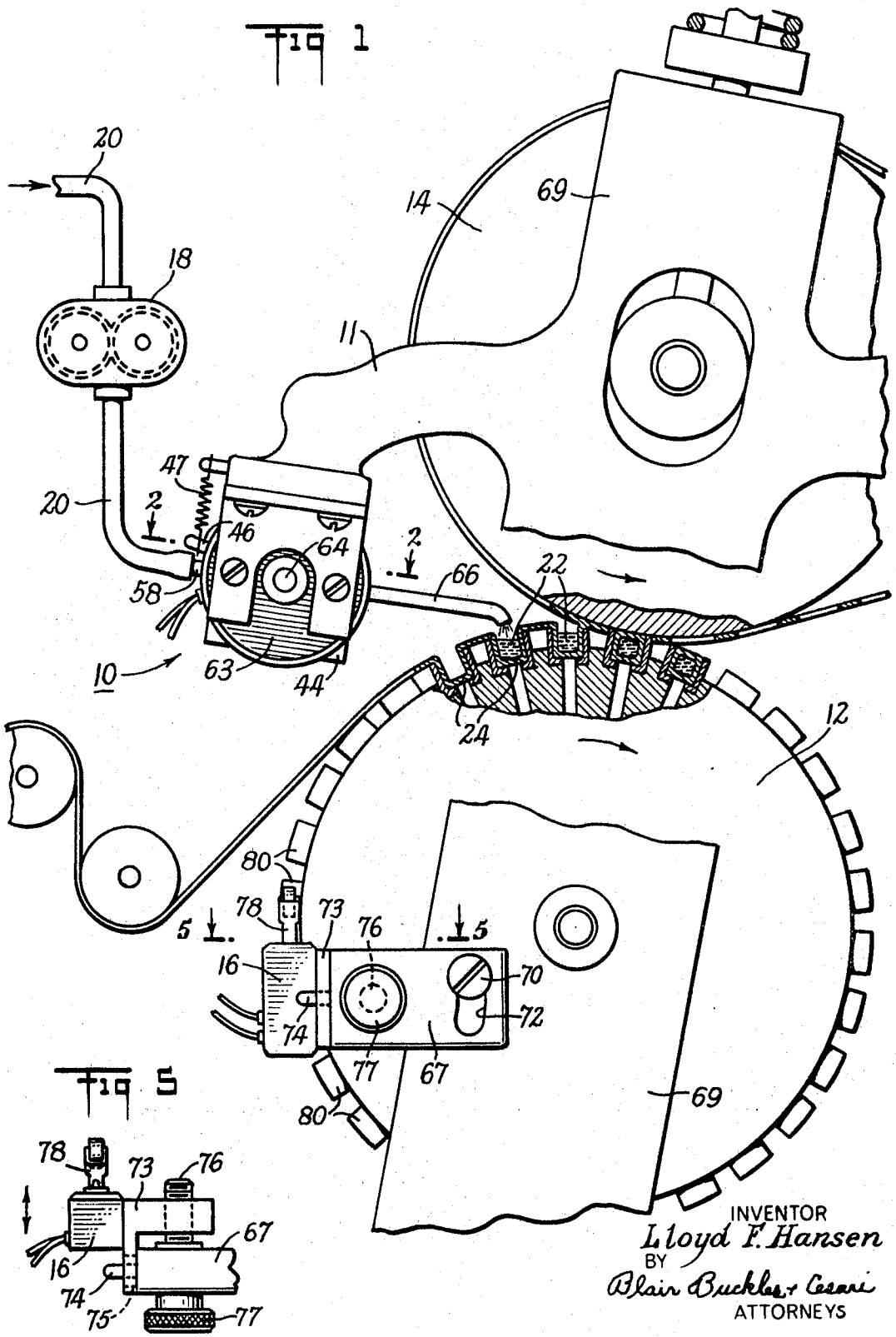


Fig 5

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Fig 2

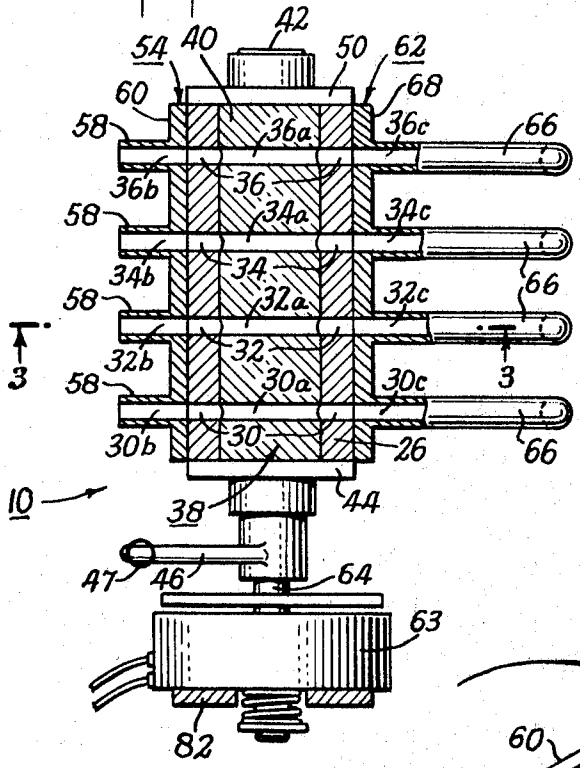


Fig 3

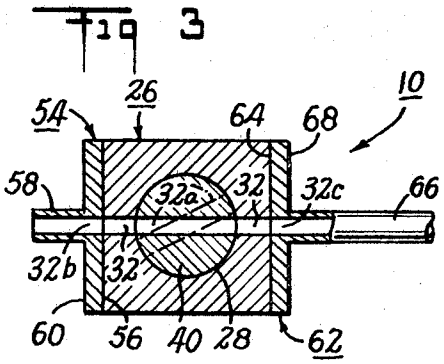
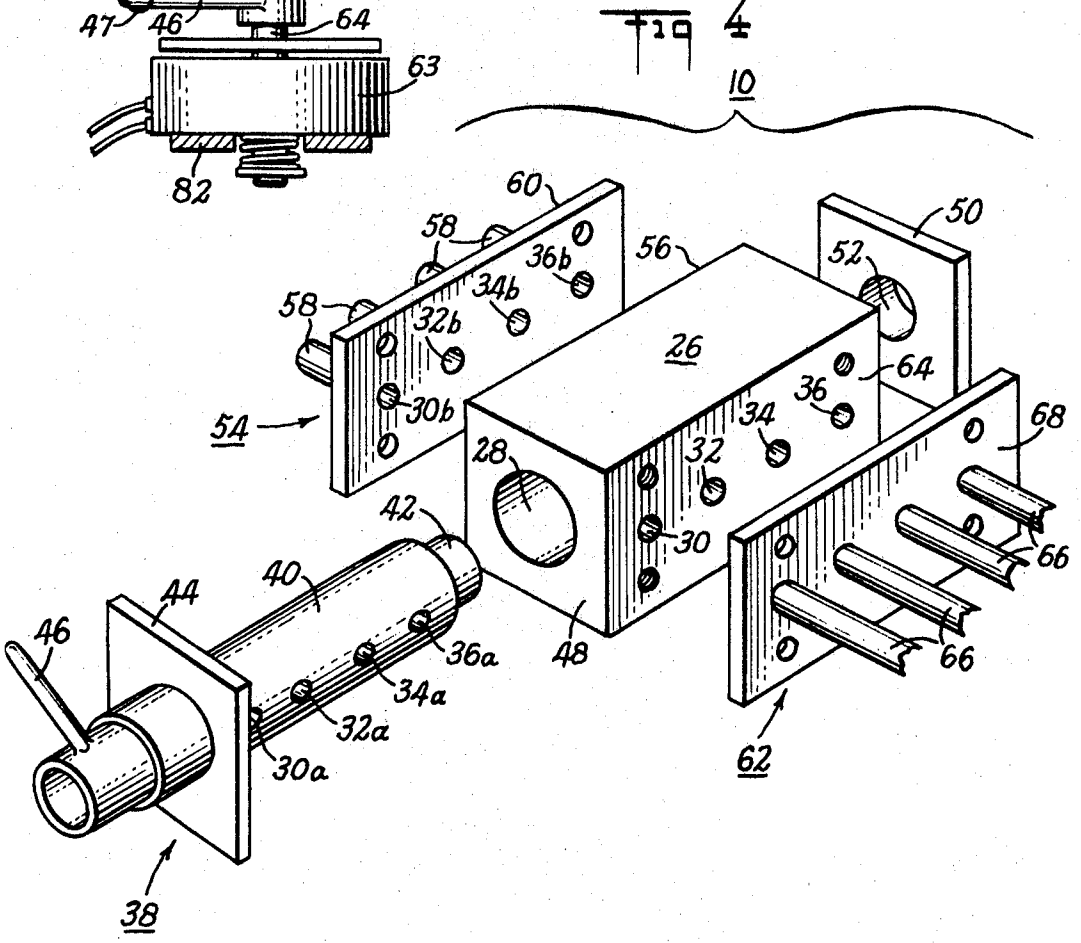


Fig 4



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CAPSULE FORMING APPARATUS WITH FLUID METERING VALVE

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U.S. Cl. 53—184 9 Claims

ABSTRACT OF THE DISCLOSURE

A fluid metering valve which is particularly adapted for use in delivering doses of liquid medicament to the die roll of a gelatin capsuling machine. A rotatable valve core is mounted in a valve block and is actuated by a rotary solenoid to intermittently open and close the valve passages. The actuation of the rotary solenoid is controlled by a microswitch actuated in response to movement of the cavities in the die roll. The metering valve is mounted adjacent the die roll, and nozzles extending from the valve deliver liquid directly and precisely to each cavity thereof when the valve passages are opened.

Liquid pharmaceutical products are often dispensed in soft shell gelatin capsules. These are made by filling with liquid a cavity lined with a gelatin film, sealing the cavity opening with a separate layer of gelatin film, and then removing the resulting gelatin capsule from the cavity.

An apparatus for thus forming gelatin capsules is disclosed in U.S. Patent No. 2,690,038 assigned to the assignee of the present invention. In that apparatus, the liquid medicament is fed in a continuous, unbroken stream to the cavities in the cavity die roll by means of a rotary gear pump. The continuous feeding of liquid in this manner, however, has not been fully satisfactory under all conditions. When liquid medicament flows in an uninterrupted stream, it not only fills each cavity in the die roll but also spills onto the gelatin film adjacent each cavity. This may result in poorly sealed capsules which leak or become contaminated during storage. Moreover, the liquid medicament which is spilled adjacent the cavities cannot be readily recovered and the loss of active liquid ingredients has proven costly.

In an effort to overcome the disadvantages of continuous liquid feeding, a piston-operated metering pump has been substituted for the rotary gear pump shown in the above patent, to produce an interrupted liquid flow intended to fill only the cavities in the cavity die roll. The piston-operated metering pump, however, has serious disadvantages. The reciprocating speed of a piston-operated pump is limited, thus limiting the number of doses of liquid it can deliver to the cavity die roll per unit time with concomitant limitations on production rate. Moreover, when operated near the limit of its reciprocating speed, a piston metering pump tends to deliver a constant rather than interrupted liquid flow, thus defeating its purpose in a capsuling machine.

Accordingly, an object of the present invention is to provide a fluid metering valve.

Another object of the invention is to provide a valve of the above character which is adapted for intermittently delivering doses of liquid to the die roll of a gelatin capsuling machine.

Another object of the invention is to provide a valve of the above character which minimizes waste of liquid medicament and which enables the production of capsules securely sealed against leakage.

Another object of the invention is to provide a valve

of the above character capable of rapid and economical operation.

A still further object of the invention is to provide a valve of the above character which is simple, inexpensive, and reliable in use.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the constructions set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a side elevation view of the fluid metering valve of the invention, mounted on a portion of a gelatin capsuling machine shown partly in section.

FIGURE 2 is a slightly enlarged top sectional view of the invention taken along the line 2—2 of FIGURE 1.

FIGURE 3 is an end sectional view of the metering valve taken along the line 3—3 of FIGURE 2 showing the valve in open and closed (dotted-line) positions.

FIGURE 4 is an exploded perspective view of the metering valve of the invention.

FIGURE 5 is a top plan view of the microswitch assembly of the invention.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring now to FIGURE 1, the fluid metering valve of the invention is shown generally at **10**. It is mounted on an extension **11** of the frame of a gelatin capsuling machine of the type shown in U.S. Patent No. 2,690,038 adjacent the nip formed by the cavity die roll **12** and the seal roll **14**. When intermittently actuated by a microswitch **16** in response to movement of die roll **12** as more fully described hereinbelow, valve **10** briefly interrupts the stream of liquid being continuously fed thereto by a gear pump **18** through tubing **20**, and then reopens to again allow free passage of liquid. Thus, through coordination of the actuation of valve **10** with the movement of cavity die roll **12**, discrete doses of liquid **22** are delivered to each of the vacuum-formed gelatin lined cavities **24** therein. The cavities are then sealed as described in the above-mentioned patent to produce gelatin capsules which are suitable for pharmaceutical use.

Referring now to FIGURE 4, the fluid metering valve comprises a valve block **26** preferably formed of a corrosion-resistant material such as stainless steel, although other suitable materials such as plastic may be used. Normally, the other members forming the metering valve will be of the same material as block **26**. Block **26** is provided with a large longitudinal bore **28** extending the length thereof. A plurality of smaller passages **30–36** are formed through block **26** perpendicular to and intersecting the large bore **28**. Block **26** is preferably of rectangular shape as shown; however, other suitable shapes will suggest themselves to those skilled in the art.

A valve core **38** is provided for mounting within the bore **28** of block **26**. It comprises a cylindrical portion **40** having a diameter sufficiently less than that of bore **28** to permit ready rotation therein; however, the diameters of cylindrical portion **40** and bore **28** should be sufficiently close to prevent leakage of liquid between their confronting surfaces. A plurality of passages **30***a*–**36***a*, equal in number to passages **30–36** in block **26** and spaced so as to register therewith in assembly, are formed diametrically through valve core **38**, and one end **42** of core **38** is turned down to form a shaft portion. A plate **44** having a bore which supports portion **40** while permitting rotation thereof is mounted adjacent the other

end. A pin **46** protrudes from the end adjacent plate **44** for attachment to a return spring **47** (FIGURE 1) as is more fully discussed below. Valve core **38** is mounted in block **26** with plate **44** abutting one end **48** thereof and with shaft portion **42** protruding from the other end.

A second plate **50** having a bore **52** which supports shaft portion **42** of valve **38** while permitting rotation thereof is mounted over protruding portion **42** and against the other end of block **26**.

A maniold plate **54** having a plurality of passages **30*b*–36*b*** formed therethrough equal in number to and spaced to register with passages **30–36** in block **26**, is fastened to the rear surface **56** thereof. Tubular connectors **58** extend from the back surface **60** of plate **54** in alignment with each passage **30*b*–36*b*** to facilitate the connection of tubing **20** from gear pump **18** as is shown in FIGURE 1.

A nozzle plate **62** is fastened to the front surface **64** of block **26**. Nozzle plate **62** has a plurality of passages **30*c*–36*c*** formed therethrough equal in number and positioned to register with the corresponding passages **30–36** in block **26**. An elongated nozzle **66** extends from the front surface **68** of plate **62** in communication with each of the passages **30*c*–36*c*** therein as shown in FIGURES 2 and 3.

Referring now to FIGURE 2, in assembly the corresponding passages through manifold plate **54**, block **26**, valve core **38**, and nozzle plate **62** communicate to form continuous passages capable of transmitting liquid entirely through the valve assembly **10**. As shown in FIGURE 3, however, valve core **38** can be rotated (dotted lines) to interrupt the flow of liquid by means of a rotary solenoid **63** which is fixedly secured to an extension **64** of valve core **38** adjacent pin **46** as shown in FIGURE 2.

Rotary solenoid **63** is actuated by a microswitch **16** (FIGURE 1) positioned adjacent cavity die roll **12** on an arm **67**. Arm **67** is pivotably supported on the capsuling machine frame **68** and can be secured in a desired position with relation to cavity die roll **12** by means of a screw **70** passing through slot **72** and into frame **68**.

Microswitch **16** is mounted to a sliding block **73** which is slidably mounted on arm **67** by means of a pin **74** passing through slot **75** as shown in FIGURE 5. A bolt **76** having a knurled knob **77** passes through arm **67** and is threadably engaged through sliding block **73**. By turning knob **77** in either a clockwise or counterclockwise direction, microswitch **16** can be moved either toward or away from roll **12** as shown by the arrows in FIGURE 5.

Microswitch **16** is actuated by a feeler **78** positioned to ride over the surface of the upstanding rim **80** surrounding each cavity of the die roll **12**. By rotatably adjusting arm **67** about pin **70**, feeler **78** can be positioned so that it is actuated at the proper instant during movement of die roll **14** as is more fully described below. Further, by means of knob **77**, the pressure of feeler **78** against rim **80** can either be increased or decreased and thus the sensitivity of microswitch **78** is adjustable as desired.

While the fluid metering valve has been shown with four liquid passages and four nozzles to correspond with a cavity die roll having four rows of cavities, it will be understood that the number and spacing of the passages and nozzles can be varied to correspond to any given die roll configuration. In addition, the passages **30*a*–36*a*** through valve core **38** have been shown placed in line so as to result in simultaneous opening and closing of the fluid metering valve passages; however, it will be understood that the passages through valve core **38** may be staggered across the periphery of cylindrical portion **40** so as to provide sequential opening and closing of the fluid metering valve passages when such a procedure is desirable.

SEQUENCE OF OPERATION

As in shown in FIGURE 1, the fluid metering valve **10** is mounted on extension **11** of the gelatin-capsuling machine frame adjacent the nip of rolls **12** and **14** by means of a bracket **82** secured to both extension **11** and rotary solenoid **63**. The placement of valve **10** and the configuration of nozzles **66** should be such that liquid medicament is delivered to each cavity **24** without unnecessary splashing and without danger of contact between roll **12** and nozzles **66**.

Liquid medicament is continuously fed to the metering valve **10** from a supply source (not shown) through tubing **20** by means of a rotary gear pump **18**.

Return spring **47** is affixed at one end to pin **46** on valve core **38** and at its other end to extension **11**. The position of pin **46** and the length of spring **47** are adjusted so as to maintain valve core **38** in an open position as shown by the solid lines in FIGURES 3. In the open position, liquid can flow freely through rotary valve **10** to be delivered to the individual cavities **24** by means of nozzles **66** (FIGURE 1).

As die roll **12** rotates in a clockwise direction (FIGURE 1), microswitch feeler **78** is intermittently actuated by contact with the outer surface of the rim **80** surrounding each cavity **24**. Actuation of microswitch **16** in turn actuates rotary solenoid **63** which revolves valve core **38** about 45 degrees to its closed position which is shown dotted in FIGURE 3. Between actuations by microswitch **16**, valve core **28** is returned to its open position by the biasing force of return spring **47**. The small degree of movement required to close and open rotary valve **10** permits relatively rapid operation of the gelatin capsuling machine to be attained with concomitant rapid production of gelatin capsules.

It can thus be seen that the position of microswitch **16** should be adjusted with relation to die roll **12** so that actuation thereof occurs at the time the portions of die roll **12** between cavities **24** are passing under nozzles **66**. In this manner, discrete doses of liquid medicament are delivered to each cavity **24**, while liquid flow is cut off to the portions of roll **12** between cavities **24** thus minimizing waste and eliminating the sealing problem encountered in gelatin capsules manufactured with prior art apparatus.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above article without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. In an apparatus requiring the intermittent delivery of fluid to a moving member, a valve mechanism for metering fluids comprising:

(A) a hollow valve block having inlet and outlet means:

(B) a valve core

(1) movably mounted in substantially fluid-tight assembly within said valve block, and

(2) having means forming at least one passage therethrough,

(a) said passage communicating with and interconnecting both said inlet and outlet means at at least one position in the movement of said valve core;

(C) means intermittently actuating said valve core in response to movement of said moving member to move said passage out of communication with said inlet and outlet means; and

(D) means for returning said valve core between each said actuation to a position wherein said passage communicates with and interconnects said inlet and outlet means.

2. Apparatus as defined in claim **1** wherein said valve has a plurality of corresponding pairs of inlets and outlets and a plurality of passages through said valve core, each said passage communicating with and interconnecting one inlet and outlet pair at one position in the movement of said valve core.

3. Apparatus as defined in claim **2** including a nozzle communicating with each said outlet for delivering fluid from said valve to a predetermined point on said moving member.

4. In an apparatus for forming liquid-filled capsules which comprises a cavity die roll and a seal roll which cooperate to form a sealed capsule, and pumping means for feeding said liquid to the vicinity of said rolls, a liquid metering valve comprising:

(A) a hollow valve block
  (1) positioned between said pumping means and said rolls, and
  (2) having inlet and outlet means
(B) a valve core
  (1) rotatably mounted in substantially liquid-tight assembly within said valve block, and
  (2) having means forming at least one passage therethrough,
    (a) said passage communicating with and interconnecting both said inlet and outlet means at at least one position in the rotation of said valve core,
(C) driving means for rotating said valve core,
(D) discharge means for delivering liquid from said outlet means to the cavities in said cavity die roll, and
(E) means intermittently actuating said driving means in response to movement of said cavity die roll to rotate said passage out of communication with said inlet and outlet means and prevent liquid flow to portions of said die roll adjacent said cavities.

5. An apparatus as defined in claim **4** and further including means for returning said valve core between each said actuation to a position wherein said passage communicates with and interconnects said inlet and outlet means to permit liquid flow to said cavities.

6. In an apparatus for forming liquid-filled capsules which comprises a cavity die roll and a seal roll which cooperate to form a sealed capsule, and pumping means for feeding said liquid to the vicinity of said rolls, a liquid metering valve comprising:

(A) a hollow valve block
  (1) positioned between said pumping means and said rolls, and
  (2) saving inlet and outlet means,
(B) a valve core
  (1) rotatably mounted in substantially liquid-tight assembly within said valve block, and
  (2) having means forming at least one passage therethrough,
    (a) said passage communicating with and interconnecting both said inlet and outlet means at at least one position in the rotation of said valve core,
(C) driving means for rotating said valve core,
(D) discharge means for delivering liquid from said outlet means to the cavities in said cavity die roll, and
(E) means intermittently actuating said driving means in response to movement of the cavities in said cavity die roll to rotate said passage relative to said inlet and outlet means.

7. A liquid metering valve as defined in claim **6** having a plurality of corresponding pairs of inlets and outlets and a plurality of passages through said valve core, each said passage communicating with and interconnecting one inlet and outlet pair at one position in the rotation of said valve core.

8. An apparatus as defined in claim **6** wherein said discharge means comprises at least one nozzle in communication with said outlet means and extending to a point adjacent the path of movement of the cavities in said cavity die roll.

9. In an apparatus for forming liquid-filled capsules which comprises a cavity die roll and a seal roll which cooperate to form a sealed capsule, and pumping means for feeding said liquid to the vicinity of said rolls, a liquid metering valve comprising:

(A) a hollow valve block
  (1) positioned between said pumping means and said rolls, and
  (2) having inlet and outlet means,
(B) a valve core
  (1) rotatably mounted in substantially liquid-tight assembly within said valve block, and
  (2) having means forming at least one passage therethrough
    (a) said passage communicating with and interconnecting both said inlet and outlet means at at least one position in the rotation of said valve core,
(C) driving means for rotating said valve core comprising a rotary solenoid mounted to said valve core to rotate said passage out of communication with said inlet and outlet means upon actuation thereof,
(D) a return spring biasing said valve core to an open position between each said actuation of said rotary solenoid, and
(E) discharge means for delivering liquid from said outlet means to the cavities in said cavity die roll.

References Cited

UNITED STATES PATENTS

2,387,747	10/1945	Cowley	53—184 X
2,520,591	8/1950	Wilmarth	137—595
2,624,164	1/1953	Donofrio	53—184 X
2,690,038	9/1954	Stirn et al.	53—184 X
3,224,462	12/1965	Lopker	137—625.19

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